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(56) Documents cited

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GB A 2054853	GB 1429866	GB 0839092
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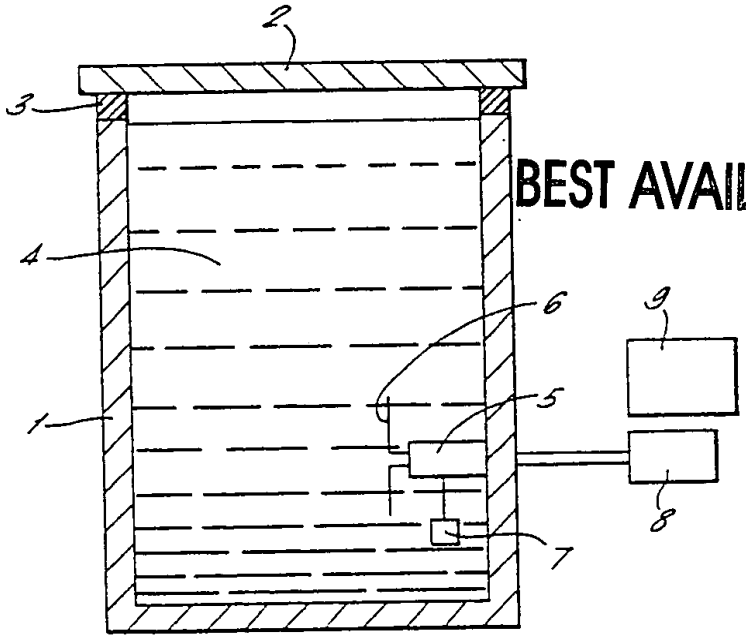
Selected US specifications from IPC sub-class G01N

(54) Method of and apparatus for determining characteristics of a fluid

(57) The moisture content of oil in a container 1 is monitored by a receiver 9 outside the casing by mechanically impulsing the casing to energise a generator 5 which powers transmission of a signal modulated by a moisture detector 7. The generator 5 can be a piezo-electric spark generator which excites a tuned circuit driving an aerial 6, the Q-factor of the circuit being varied according to the resistance of the detector 7. The generator may be electromagnetic or it may be acoustic.



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The drawing(s) originally filed was/were informal and the print here reproduced is taken from a later filed formal copy.

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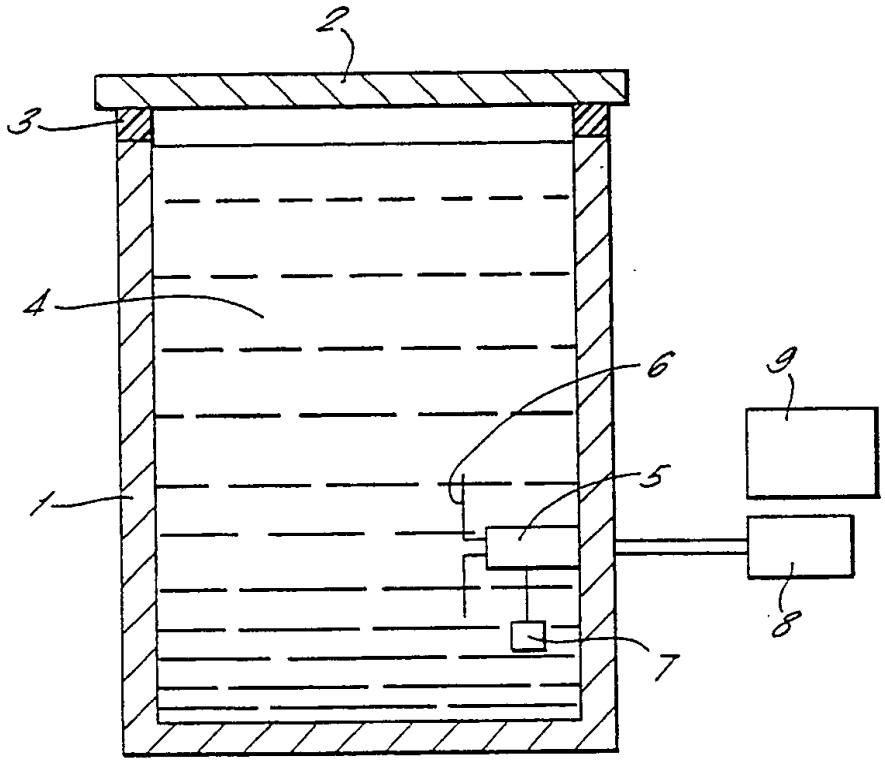

SPECIFICATION

Method of and apparatus for determining characteristics of a fluid

This invention relates to a method of apparatus for determining characteristics of a fluid, and particularly of a fluid contained in a closed container.

In electrical power supply systems transformers and switchgear are often housed in a closed container surrounded by a mineral oil or other electrically insulating liquid, and the characteristics of such liquids can be adversely affected by the presence of contaminents, for example solid particles or water. The presence of such contaminents can shorten the life of the equipment in the container, and can at times represent a considerable hazard. Ideally no water would be present in such a container although in practice up to about 20ppm is acceptable.

Generally the containers are closed by a lid with an interposed gasket, which totally encloses the oil apart possibly from some small "breather holes" above the oil level.

Thus, there is a need for a method of apparatus for determining characteristics of a fluid in a container, and in particular the presence of a contaminent such as water in oil.

According to this invention there is provided a method of determining characteristics of a fluid in a container, comprising generating a signal within the container in response to a mechanical force applied to the container from outside, the signal having characteristics dependent upon the characteristics of the fluid in the container, and detecting and interpreting the signal outside the container.

Also according to this invention there is provided apparatus for carrying out the method of the invention, comprising a signal generator for mounting on the inside of a wall of a container; mechanical force applying means for applying a mechanical force to the outside of the wall of the container; and a receiver adapted to receive a signal generated in the container by the signal generator in response to a force applied by the mechanical force applying means.

The method and apparatus of this invention provide a simple means by which a fluid such as oil in a substantially closed container can be checked for the presence of a contaminent such as water, the checking being carried out outside the container without opening the container.

This invention will now be described by way of example with reference to the drawing which is a diagrammatic sectional view through a container and associated apparatus according to the invention for carrying out the method of the invention.

Referring to the drawing, this shows a metal container 1 closed by a metal lid 2 with an interposed non-metallic gasket 3, the container 1 being full of oil 4. In a particular embodiment the container may contain an electrical transformer or switchgear forming part of an electrical power supply system, but for simplicity no such equipment is shown in the drawing.

Mounted on the inside of the wall of the container 1 is a piezo-electric generator 5 of the type responsive to a mechanical shock to provide a high voltage output. The generator 5 includes a pair of electrodes providing an air gap across which the high voltage output is applied to produce a spark. This sparking excites a tuned circuit including an aerial 6 mounted on the generator 5 in the container 1, the arrangement being such that in response to a mechanical shock the generator 5 effects transmission of a radio frequency signal from the aerial 6.

Coupled to the generator 5, and in the container 1, is a sensing device 7 which is sensitive to any moisture content in the oil 4, for example by changing in resistance, and which controls the signal transmitted from the aerial 6, for example by affecting the Q factor, to be indicative of such moisture content.

Shown outside the container 1 are a mechanical impulse generator 8 which can be used to apply mechanical shocks to the container, and a receiver 9 tuned to receive the signal transmitted from the aerial 6, for example by affecting the Q factor, which signal can leave the container 1 through the gasket 3 and/or any breather holes provided in the container 1.

For use of the apparatus, the impulse generator 8 is used to apply a mechanical shock to the outside of the wall of the container, preferably adjacent the location of the generator 5 on the inside, and the resulted UHF signal transmitted from the aerial 6 and indicative of the amount of water in the oil sensed by the sensing device 7, is received and analysed by the receiver 9 outside the container 1.

The receiver 9 can include logic circuits whereby it will operate to give a simple indication as to whether or not the amount of water in the oil exceeds a predetermined amount, or otherwise the receiver 9 can give an absolute indication of the amount of water present.

As mentioned above, the container 1 may be part of an electrical power supply system where there will be an environment of high electromagnetic interference signals, and thus correlation techniques are preferably used.

As a modification of the apparatus described above, the radio frequency signal can be produced simply by applying the output voltage of the piezo-electric crystal, after rectification, across a pair of electrodes defining an air gap, the radio frequency signal being produced if breakdown occurs and a spark jumps the air gap.

The impulse generator 8 can be used to apply a single mechanical shock to the container 1, or otherwise can be operated to provide a series of impulses to provide a substantially continuous supply of power for the generator 5 and thus a substantially continuous output signal for detection by the receiver 9.

Instead of the mechanical impulse generator 8, the necessary power for the generator 5 can be provided by means acting on the wall of the container 1 to continuously distort the wall sufficiently for operation of the generator 5, thereby to obtain a continuous output signal at the aerial 6.

The piezo-electric generator 5 can be replaced by an electromagnetic device responsive to mechanical shocks applied to, or to distortion of, the wall of the container 1, the device responding by varying flux linkages with a coil thereby to provide the required signal for transmission for the aerial 6.

The piezo-electric generator 5 can otherwise be replaced by an acoustic signal generator responsive to the applied mechanical force to provide an acoustic signal indicative of the moisture level sensed by the sensing device 7 and receivable by the receiver 9 outside the container 1.

CLAIMS

1. A method of determining characteristics of a fluid in a container, comprising generating a signal within the container in response to a mechanical force applied to the container from outside, the signal having characteristics dependent upon the characteristics of the fluid in the container, and detecting and interpreting the signal outside the container.

2. A method as claimed in Claim 1, in which the signal generated is a radio frequency signal which is transmitted within the container for reception outside the container.

3. A method as claimed in Claim 1, in which the signal generated is an acoustic signal.

4. A method as claimed in any preceding claim, in which the mechanical force is in the form of an impulse or a series of impulses.

5. A method as claimed in any one of Claims 1 to 3, in which the mechanical force is a continuously varying force.

6. Apparatus for use in carrying out a method as claimed in any preceding claim, comprising a signal generator for mounting on the inside of a wall of a container; mechanical force applying means for applying a mechanical force to the outside of the wall of the container; and a receiver adapted to receive a signal generated in the container by the signal generator in response to a force applied by the mechanical force applying means.

7. Apparatus as claimed in Claim 6, as dependent upon Claim 2, in which the signal generator is a piezo-electric generator.

8. Apparatus as claimed in Claim 7, in which the piezo-electric generator includes a pair of electrodes defining an air gap across which a spark passes in response to the mechanical force applied to the container, the spark exciting a tuned circuit including an aerial from which the signal is transmitted within the container.

9. Apparatus as claimed in Claim 6, as dependent upon Claim 2, in which the signal generator is an electro-magnetic device in which the mechanical force changes flux linkages to a coil to generate the signal.

10. Apparatus as claimed in Claim 6, as dependent upon Claim 3, in which the signal generator is an acoustic signal generator.

11. Apparatus as claimed in any one of Claims 6 to 10, including a sensing device operative to sense the amount of a contaminent in the fluid in the container and control the signal generator to provide a signal characteristic of such amount.

12. Apparatus as claimed in Claim 11, in which the receiver operates to give a simple indication as to whether or not the amount of a contaminent in the fluid is above a predetermined amount.

13. Apparatus as claimed in Claim 11, in which the receiver gives an indication of the absolute amount of the contaminent in the fluid.

14. Apparatus as claimed in any one of Claims 6 to 13, including a container for the fluid, the container being closed by a lid with an interposed gasket.

15. Apparatus as claimed in Claim 14, in which the container contains oil.

16. Apparatus as claimed in Claim 15, as dependent upon Claim 11, in which the contaminent is water.

17. A method of determining characteristics of a fluid in a container, substantially as hereinbefore described with reference to the drawing.

18. Apparatus for use in determining characteristics of a fluid in a container, substantially as hereinbefore described with reference to the drawing.

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